

## NELAC Radiochemistry PT Scoring Criteria

The results from a participating laboratory are classified as “Acceptable” or “Not Acceptable” based on the criteria in US EPA’s “National Standards for Water Proficiency Testing Studies Criteria Document.” The tests in the document include an evaluation of the *average* of the required three independent determinations for each radionuclide and an evaluation of the *range* of the three results for each radionuclide. Acceptance limits for the two tests are provided in Table 1 below. Following the table is a section that describes the method used for determining the acceptance limits for the average and range and for evaluating each participant’s results.

**Table 1. Acceptance Limits for the Average and Range**

Analyte	Assigned Value (μ), pCi/L	Acceptance Limits for Average, pCi/L	Acceptance Limit for Range, pCi/L
Gross Alpha	\$ 3 and # 20 > 20 and # 75	$\mu \pm 8.66$ $\mu \pm 0.433\mu$	21.8 1.09μ
Gross Beta	\$ 4 and # 50 > 50 and # 65	$\mu \pm 8.66$ $\mu \pm 17.3$	21.8 43.6
<sup>133</sup> Ba	\$ 9 and # 50 > 50 and # 110	$\mu \pm 8.66$ $\mu \pm 0.173\mu$	21.8 0.436μ
<sup>60</sup> Co	\$ 10 and # 100 > 100 and # 120	$\mu \pm 8.66$ $\mu \pm 0.0866\mu$	21.8 0.218μ
<sup>134</sup> Cs	\$ 10 and # 96	$\mu \pm 8.66$	21.8
<sup>137</sup> Cs	\$ 20 and # 100 > 100 and # 240	$\mu \pm 8.66$ $\mu \pm 0.0866\mu$	21.8 0.218μ
<sup>65</sup> Zn	\$ 30 and # 50 > 50 and \$ 360	$\mu \pm 8.66$ $\mu \pm 0.173\mu$	21.8 0.436μ
<sup>3</sup> H	\$ 1000 and < 4000 \$ 4000 and # 32,000	$\mu \pm 294\mu^{0.0933}$ $\mu \pm 0.173\mu$	$741\mu^{0.0933}$ 0.436μ
<sup>131</sup> I	\$ 1 and # 15 > 15 and # 30	$\mu \pm 3.46$ $\mu \pm 5.20$	8.72 13.1
<sup>226</sup> Ra	\$ 1 and # 20	$\mu \pm 0.260\mu$	0.654μ
<sup>228</sup> Ra	\$ 1 and # 20	$\mu \pm 0.433\mu$	1.09μ
<sup>89</sup> Sr	\$ 10 and # 70	$\mu \pm 8.66$	21.8
<sup>90</sup> Sr	\$ 2 and # 45	$\mu \pm 8.66$	21.8
U	\$ 2 and # 35 > 35 and # 70	$\mu \pm 5.20$ $\mu \pm 0.173\mu$	13.1 0.436μ

## Data Evaluation Procedure

### Notation:

$x_i$	is the $i^{\text{th}}$ result reported by the participant ( $i = 1, 2, 3$ )
$\bar{x}$	is the average of the participant's three results
$r$	is the range of the participant's three results ( $\max - \min$ )
$\mu$	is the assigned value (accepted true value)
$\sigma$	is the nominal (expected) standard deviation for the measurement method for a single determination (see Table 2)
LL	denotes a lower acceptance limit
UL	denotes an upper acceptance limit

### Procedure to Test the Average:

1. Calculate the lower and upper acceptance limits for the average.

$$LL_{\bar{x}} = \mu - \sigma\sqrt{3} \quad UL_{\bar{x}} = \mu + \sigma\sqrt{3}$$

2. Calculate the average,  $\bar{x}$ , of the participant's results.

$$\bar{x} = \frac{x_1 + x_2 + x_3}{3}$$

Judge the average to be acceptable if  $LL_{\bar{x}} \leq \bar{x} \leq UL_{\bar{x}}$ .

### Procedure to Test the Range:

1. Calculate the upper acceptance limit for the range.

$$UL_r = 4.358\sigma$$

2. Calculate the range,  $r$ , of the participant's results.

$$r = \max(x_1, x_2, x_3) - \min(x_1, x_2, x_3)$$

Judge the range to be acceptable if  $r \leq UL_r$ .

**Note:** All the acceptance limits are “three-sigma” limits. The acceptance limits for the average are calculated using the standard deviation of the average, which equals  $\sigma / \sqrt{3}$ . The upper acceptance limit for the range is calculated using the standard deviation of the range, which equals  $1.4526\sigma$ .

**Table 2. Nominal Standard Deviations ( $\sigma$ ) \***

Analyte	Assigned Value ( $\mu$ ), pCi/L	Standard Deviation ( $\sigma$ ), pCi/L
Gross Alpha	\$ 3 and # 20 > 20 and # 75	5 0.25 $\mu$
Gross Beta	\$ 4 and # 50 > 50 and # 65	5 10
$^{133}\text{Ba}$	\$ 9 and # 50 > 50 and # 110	5 0.10 $\mu$
$^{60}\text{Co}$	\$ 10 and # 100 > 100 and #120	5 0.05 $\mu$
$^{134}\text{Cs}$	\$ 10 and # 96	5
$^{137}\text{Cs}$	\$ 20 and # 100 > 100 and # 240	5 0.05 $\mu$
$^{65}\text{Zn}$	\$ 30 and # 50 > 50 and \$ 360	5 0.10 $\mu$
$^3\text{H}$	\$ 1000 and < 4000 \$ 4000 and # 32,000	170 $\mu^{0.0933}$ 0.10 $\mu$
$^{131}\text{I}$	\$ 1 and # 15 > 15 and # 30	2 3
$^{226}\text{Ra}$	\$ 1 and # 20	0.15 $\mu$
$^{228}\text{Ra}$	\$ 1 and # 20	0.25 $\mu$
$^{89}\text{Sr}$	\$ 10 and # 70	5
$^{90}\text{Sr}$	\$ 2 and # 45	5
U	\$ 2 and # 35 > 35 and # 70	3 0.10 $\mu$

\* from US EPA's "National Standards for Water Proficiency Testing Studies Criteria Document"